DISCUSSIONS

RAINFALL AT MUSCATINE, IOWA[1]

This paper gives in a concise form the results of a rainfall record kept in conjunction with the water works system, and affords an excellent example of valuable records, the keeping of which it seems proper to encourage. It may safely be stated that wherever rainfall and temperature records have been kept by water works companies or water departments, the results have invariably proven useful to a degree fully justifying the trouble and expense of keeping such records.

A standard United States Weather Bureau pattern rain gage can be purchased at the present time for about $6.50. Maximum and minimum thermometers cost about $5.00 each. With such simple and inexpensive instruments, any water works superintendent can obtain records which are certain to prove of increasing value the longer they are continued. In connection with maintaining records of rainfall, the writer has one or two suggestions:

The greatest difficulty in the process is involved in obtaining a correct record of snowfall. It has been repeatedly shown that the ordinary rain gage overflow can, when used as a snow gage, gives deficient results in most storms. A better procedure seems to be to expose a flat snow board, consisting of a thin board, covered with a sheet of white cotton flannel, about 12 inches square, on the ground in some location where the snow does not drift. After a snowstorm, the rain gage overflow can is inverted on the snowboard, and a prism of snow cut out and melted or measured in the usual way. The snowboard is then dried, and exposed on the top of the newly fallen snow.

Another matter worthy of consideration in the keeping of such records is the recording and publication of the number of rainfall days in each month. It makes a great difference as regards the amount of water available for supplying reservoirs from a rainfall of say 4 inches in a month whether it falls in four days with an

[1] JOURNAL, 1920, page 127.

average of 1 inch per day, or whether it falls on ten days with an average of 0.4 inch per day. Water works superintendents connected with either gravity or underground supplies, but deriving their water from large rivers, may not fully appreciate the value which meteorological records may have to them. As a matter of fact, water consumption is closely correlated with temperature and rainfall; furthermore, in the case of waters subject to turbidity and pollution, the condition of the water itself is in many respects dependent on weather conditions. Accordingly, it seems appropriate to suggest not only the advisability of maintaining rainfall and temperature records in conjunction with all gravity and underground water supplies, but also of maintaining such records in conjunction with filtration plants.

In this connection, it seems proper to call attention to the recent organization of the American Meteorological Society, for the purpose, among others, of fostering and stimulating the maintaining and utilization of meterological records, especially rainfall records. Water works men interested in this subject can no doubt obtain membership and participate in the benefits of such work, especially in view of the fact that the Society has expressed a desire to be informed as to locations where additional rain gages are needed. Those interested should address the Secretary, Chas. F. Brooks, U. S. Weather Bureau, Washington, D. C.

ROBERT E. HORTON.[2]

WEIGHTS AND CLASSES OF CAST IRON PIPE

The writer is grateful to the Editor for calling attention to a failure to clearly express his thought in the discussion of weights and classes of cast iron pipe.[3] The question of different sizes was not intentionally introduced as the important feature.

A bridge may give way and thereby influence conclusions but it would be unfortunate if engineers ceased their efforts to secure a consistent relation between the several members of a bridge truss or of any structural work. For this purpose factors of safety are often used.

[2] Consulting Hydraulic Engineer, Voorheesville, Albany Co., N. Y.

[3] JOURNAL, May, 1920, page 366.

The American Water Works Association has the credit of determining, fixing and publishing the stresses that should not be exceeded in mains under water pressure. Since with low heads the walls of a pipe may be too thin to admit of transportation and safe handling "Class A" for heads of 100 feet is given a high factor of safety against breakage and this becomes a high factor of safety against bursting pressure. As the specification provides for tensile strength in the metal used for pipes it seems reasonable to use tensile strength factors for the pipe itself.

In these brief notes let only one size, (12 inch), and but one quality of iron, (tensile strength, 18,000 pounds) be considered. For 12-inch inside diameter pipe, "Class A" shows a factor of safety of 37 against bursting pressures. But for the risk in handling the pipes that factor might safely be less than half as great. "Class B" shows a factor of safety of 21 for the specified head of 200 feet. It is fairly evident that if a pipe can be transported and safely laid where the head is to be 100 feet the same pipe can be transported and safely laid where the head is 200 feet. It is also clear that if we could discover an American Water Works Association authority for using 12-inch pipes under a factor of safety of 18 instead of 21, "Class A" pipe could be substituted for "Class B", and "Class B" would go out altogether. That would be a marked advantage.

Skipping over one class for a moment, consider "Class D" for a head of 400 feet. Transportation and laying do not call for special increments in "Class D" pipes. The factor of safety for "Class D" is 13. Now it may be said that if a factor of safety of 13 is suitable for 400 feet head, a factor of safety of 18 is proper for 200 feet head, and "Class B" does go out. There is still another class, "Class C." If "Class A" pipe be substituted for "Class C" pipe the factor of safety with 300 feet head would be 12.46. It might with general consent be said that if a head of 400 feet demanded a factor of safety of 13, a distribution system under 300 feet head would be reasonably secure with a factor of safety of 12.46. Then there would be two classes instead of four classes. "Class A" for pressure up to 300 feet and "Class B," as the present "Class D" would then be called, for service up to heads of 400 feet, and except for the thickened walls to prevent breakage in laying "Class A" the factor of safety would be fairly uniform throughout. Besides this conforms to average experience. No one would hesitate to lay a main under a head of 300 feet when assured that the factor of safety was

twelve, that the metal was of good quality and that the pipe had been thoroughly tested under a pressure of 300 pounds to the square inch.

It is true the figures used above are those of the specification. If correction is to be made for irregular thickness, rust and the like, it is well to note that the correction would not lead to heavier than "Class A" weights for pipes under 100 or 200 feet head, but would need to be applied to pipes of 400 feet head where the safety factor now is least.

The specification of the New England Association, unchanged for nearly twenty years, seems far more creditable and satisfactory. From it such weights as may be desired can be selected and the selection can depend upon the location, character of service required, anticipated future changes and other considerations, all of which should be better understood by those in immediate charge than by pipe founders hundreds of miles away, or by agents who are provided with contradictory figures.

It may be noted that the New England specification invites the placing among the rocks and boulder-clays of that district 12-inch pipes that are lighter by 60 pounds per length than the lightest pipes specified by this Association. And in many cities pipes lighter still for gas mains have been safely laid, perhaps at less depth in many cases but even so in greater danger from traffic.

There would be some advantage in designating weights by localities; "Chicago weights" where filled in streets are full of acids. "Rural weights" where mains may not be disturbed in a century. "Subway weights" where subways are to be built under the mains as soon as they are laid, but even these items could be outlined under the title of General Information.

H. F. DUNHAM.[4]

EFFECT OF REAGENTS ON FLOCCULATION

Mr. Smith in his paper,[5] "Removal of Clay and Silica from Water," has presented a very interesting phase of the varying effects of reagents on flocculation and the results set forth are in direct accord with the most recent views of colloidal chemists.

[4] Engineer, 32 West 40th Street, New York. This letter was dated March 25; Mr. Dunham's letter on page 773 was dated June 10.

[5] JOURNAL, May, 1920, page 302.

Silicic acid is an emulsoid-type colloid of negative charge and it exerts a pronounced protective effect on a colloidal suspension of the same electric sign, as, for example, clay and silica, making them much more difficult to flocculate. This effect can be counteracted by their preferential adsorption of a strong positive ion, such as calcium, but, as pointed out by Mr. Smith, the element of time is an important factor in bringing this result about.

The preliminary treatment of turbid waters with milk of lime by thorough mixing and sufficient period of contact for maximum adsorption is conducive to best results, where this system of dosing is in use.

Moreover, by reason of this preliminary liming the particles are in best possible condition to be immediately acted upon by the force set in motion through the precipitation of the positive colloid Al_2 $(OH)_3$ and therefore not only a lesser amount of reagent is required but the rate of flocculation is materially increased.

The importance of this rapidity of initial flocculation is often lost sight of, although it has a decided practical bearing on the size of sedimentation unit required.

A slow rate of flocculation means a relatively long period of detention before attaining the maximum rate of settling whereas with treatment conditions right for an energetic kick off, the maximum rate of settling will soon be developed.

The writer believes that many operators have been slow to realize the practical importance of these various considerations and when we bear in mind that the reagents used in dosing represent dollars unrecoverable their most economical utilization merits detailed study and research. Unfortunately there are no set rules which apply to all cases and to meet the varying requirements in the most efficient manner implies individual analysis and systematic experimentation by engineers qualified in training and experience to solve these problems.

WILLARD A. DEANE.[6]

[6] Research Engineer, The Dorr Company, 101 Park Avenue, New York.

ELECTRIC CAST IRON PIPE AND PREPARED OR FACTORY MADE LEAD JOINTS[7]

The article on electric cast iron pipe and prepared joints by Mr. Carson has been read with much interest. It is not believed any doubt exists among engineers that a better grade of iron is possible of procurement and that a better, more uniform, and consequently a stronger pipe can be made. If the tensile strength of the cast-iron can be made higher, it is obvious a "thinner section" or lighter pipe can be cast to withstand the same pressure and with just as high, if not higher, factor of safety because of its assured uniformity.

It is believed by the writer, after a careful personal inspection of the process, that a better quality of cast-iron can be made in the electric furnace than in the old-type furnace. With the rising price of pipe, now over three times as high as it was in 1914, it is fitting that if possible the weight should be reduced, provided the strength can be retained. Tests made under the supervision of the writer have satisfied him the quality of the iron is better; it is more uniform and close grained in structure, there being, as Mr. Carson states, sufficient graphite to allow the pipe to be easily machined.

As for the prepared or factory-made joints, we believe the process as developed by J. R. McWane is sound both in theory and in practice. Certainly, more uniform joints can be secured, and after each is made, it can be closely examined, which in itself is a wonderful improvement and a great point in its favor. The cost of the work can be reduced by a process of "assembling" at the plant, thus standardizing and cutting down a certain amount of overhead expense, provided, of course, that the charge by the manufacturer for such joint is not made too high. At any rate, the writer is firmly of the opinion that much greater uniformity of joints can be procured. Contractors may prefer for a while to pour their joints by the old-fashioned method because this is apparently something new, and like most contractors, they hate to make the shift. As a matter of fact, from the contractor's point of view, this prepared joint is a great deal easier to handle than the old handmade kind, for reasons which should be perfectly obvious.

WEBSTER L. BENHAM.[8]

[7] JOURNAL, July, 1920, page 477.

[8] Johnson & Benham, Consulting Engineers, New York and Kansas City.

MONTHLY VARIATIONS IN BACTERIA IN EFFLUENTS FROM DIFFERENT STAGES OF PURIFICATION PROCESS AT INDIANAPOLIS

A brief summary of the past five years work on bacterial content of the Indianapolis supply, in the various stages of purification, may be of interest. The three tables summarize the information. Briefly the conclusions are:

Bacterial concentration in streams and partly purified water is inversely proportional to the temperature.

The proportion of the total bacterial flora which is of the Colon group is likewise inversely proportional to the temperature.

TABLE 1

Summary of five years' test for bacteria per cubic centimeter, and B. coli per 100 cc. at Indianapolis

	TEST	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
Raw water	20°	4,632	10,743	7,020	1,555	1,297	1,354	585	406	422	1,272	1,014	2,293
	37°	1,433	2,732	2,293	736	966	1,063	453	356	462	616	625	1,017
	Colon	6,637	5,650	9,076	3,458	3,727	1,447	1,036	870	695	917	5,566	2,601
Settled water	20°	2,546	3,594	1,702	381	292	148	147	209	122	179	508	1,544
	37°	627	428	224	131	193	137	152	360	180	125	244	460
	Colon	2,150	1,071	631	182	282	108	156	69	44	51	962	963
Filtered water	20°	420	357	90	29	30	45	85	38	29	24	78	264
	37°	88	50	49	10	16	41	64	48	53	18	19	41
	Colon	389	103	27	4.6	4.5	5.7	8.0	3.6	4.9	5.0	27.3	104
Sterilized water	20°	47	87	5	4	5	6	7	6	5	7	7	71
	37°	16	15	10	5	5	5	5	6	5	6	6	13
	Colon	2.0	0.74	0.49	0.39	0.56	0.37	0.3	0.47	0.32	0.7	0.49	2.1

While the resistance of organisms of the colon type is less than the total bacterial flora, in a water undergoing purification, the sterilization by means of chlorine products exercises a selective action against organisms of this group. In the five years study 3.1 per cent of all 37° growers in the raw water were B. coli. Settling and filtration reduced this proportion to 1.5 per cent and 1.6 per cent respectively. This indicates a certain selective action against, or speaking correlatively, an inferior resistance of B. coli when compared to the total flora capable of growing at 37°C. Ster-

TABLE 2

Comparison of 5 years' total counts at 20°C. and 37°C. expressed in percentages which 37° count is of the 20° count

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	AVERAGE
Raw water.....	31	25	33	47	74	77	78	88	110	48	55	44	
Settled water....	25	12	13	35	66	93	103	172	147	70	48	30	
Filtered water...	21	14	21	35	53	91	75	126	183	75	24	15	
Sterilized water..	34	17	200	125	100	83	71	100	100	85	85	18	
Percentage of 37° organisms which are bacteria of the Colon Group (5 years)													
Raw.....	4.6	2.1	4.0	4.7	3.9	1.4	2.3	2.4	1.5	1.5	8.9	2.6	3.1
Settled.....	3.4	2.5	2.8	1.4	1.5	0.8	1.0	0.2	0.2	0.4	4.0	2.0	1.5
Filtered.....	4.4	2.0	1.4	0.4	0.3	0.1	0.1	0.07	0.1	0.3	1.4	2.5	1.6
Sterilized.....	0.12	0.05	0.05	0.08	0.11	0.07	0.06	0.08	0.06	0.1	0.08	0.17	0.10
Percentage of organisms of the Colon Group which are fecal type (positive reaction to Methyl Red) 3 years													
Raw.....	55	71	73	74	79	62	61	46	73	71	64	71	66
Settled.....	63	63	61	66	78	65	48	23	72	66	58	65	61
Filtered.....	66	80	71	65	70	46	32	23	47	57	58	67	58
Sterilized.....	70	60	34	31	13	42	25	18	50	57	55	81	56

TABLE 3

Effect of various steps of purification process on bacterial growth evidenced by reduction of 20° growers, 37° growers and colon group

	TEST	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
Reduction by settling and partial coagulation	20°	45	67	76	76	78	89	75	49	71	86	55	33
	37°	66	84	90	82	80	87	70	—1	61	80	61	60
	Colon	68	81	93	95	93	93	85	92	94	94	83	63
Reduction by filtration of settled water	20°	83.5	90	94.7	93.4	90	70	43	82	76	87	85	83
	37°	86	88	92	92	92	70	58	87	71	84	92	91
	Colon	82	91	96	97.5	98.2	94.8	95	95	89	90	97	89
Reduction by sterilization of filtered water	20°	89	75	94.5	86	84	87	91.8	84	83	71	91	73
	37°	82	70	47	50	69	88	92	87.5	91	67	69	68
	Colon	99.5	99.3	98.2	99.2	98.8	99.4	99.6	98.7	99.4	98.6	98.2	98.1
Reduction by entire process	20°	99	99.2	99.93	99.75	99.62	99.56	98.8	98.5	98.8	99.45	99.4	96.9
	37°	98.9	99.5	99.5	99.3	99.5	99.5	98.9	98.3	98.9	99.0	99.0	98.9
	Colon	99.97	99.99	99.99	99.99	99.98	99.98	99.97	99.95	99.96	99.93	99.99	99.92

ilization, however, reduces the percentage of .37° organisms which are B. coli to 0.1 per cent. B. coli unquestionably succumb to chlorination much more completely than the general run of blood-temperature growers.

Of the total number of coli-type organisms present, the methyl red positive, or so called fecal type, survive purification processes, step by step, in increasingly less proportion as the temperature rises.

The B. coli content of the raw water ranges from a minimum of 695 per 100 cc. to 9076 per 100 cc. This minimum figure is higher than the limit set in 1914 by the International Joint Commission. Their paragraph 4 sets a limit of 500 B. coli per 100 cc. for a purifiable raw water. At the time their report was made public, the writer felt that the limit was not set with sufficient information as to actual performances. In his opinion practically no supply in the Central West has a raw water that does not exceed this limit, yet the data of this plant show over a five year average, a range of B coli in finished product from 0.3 to 2.1 B. coli per 100 cc. The later years summarized reduce the maximum figure to less than 2.1.

There is unquestionable and decided need of work in a number of more active laboratories before too broad conclusions are made to certain ideas. This has a particular bearing upon the subject of standard methods of water analyses. It is about time for the American Water Works Association to assert its rights in the matter of methods of examining public water supply.

HARRY E. JORDAN.[9]

[9] Superintendent of Filtration, Indianapolis Water Company.

IMPORTING LABOR

While the writer appreciates the present demand for labor and the conditions so well expressed in Mr. Ericson's letter,[11] something within rebels a bit at the thought of ever inviting to this country any classes of people without they entertain a strong desire and a plausible plan to remain here and become Americans. The writer has the same feeling in regard to individuals, excepting those who might come in a professional capacity or as visitors. It may be the dwarfed conservatism of age that affects him but it is not easily shaken off.

A hundred years ago this country was in great need of labor. Few, comparatively, thought any harm could follow the importation of animals from Africa. We do not apply the same term now and we do not feel very well satisfied with the commercial venture of that period. The slaves found friends here. That was the first round in the ladder that led up to equal political rights. But during the same interval there was awakened in the cultivated masters a dominant, autocratic spirit that has been referred to in halls of Congress and in colleges also as "a disgrace." That is a mild term. But that spirit as one may now see it illustrated in both the South and North, will become more aggressive and reprehensible with every addition to the numbers of those who serve in a lowly or "degraded" capacity.

"Menial and rough work our white labor will not longer do" cannot be so very different from the work of the white people who carried our country with reasonable success through two or three hundred years of its history in which occurred wars and recovery from wars. The writer will grant this: many white men do not work now in the spirit of the pioneers. The sturdy laborer (white) observed from an office window, takes twelve steps for each half shovel of earth moved one cast from between the rails on Broadway. His eye is on the foreman. His spirit all wrong, made so in good part by the Unions.

If workers would think of what they could make for others or themselves as well as of what they can get, the outlook would be more hopeful.

How refreshing it is in these days to come upon an incident like this as described by John Macaulay:

[11] JOURNAL, July, 1920, page 611.

In 1777 at the age of 23 William Murdoch applied to Boulton & Watt for work. Boulton had nothing for him and was turning him away when he noticed a hat of peculiar pattern in Murdoch's hand. "What is your hat made of?" "Timber, Sir." "What, wood?" "Aye, man." "How was it made?" asked Boulton in astonishment. "I turned it masel in a lathey of ma ain makin." Murdoch was given a place at once and it should be remembered that he made the first steam propelled vehicle in England.

It is true that incidents similar in spirit occur now, but how rarely in proportion to the number of workers. Would the plan of importing Chinese labor tend to insure greater interest in men and work rather than in the results of labor?

When the war ended so unexpectedly, there was apparently every sound reason for the wealthy and for workers in this country to rejoice and in a thankful spirit to work on with greater diligence and to practice greater economy. Instead of that there were unheard-of extravagance and strikes without limit, although each sensible individual knew well that every like demonstration increased the difficulties of the people and of the overburdened administration at Washington. Would the importation of Chinese labor tend to arouse a right national spirit in an emergency like the present? Would it increase and strengthen the bonds of sympathy between the wealthy and the workers? Or between the workers themselves? The writer can hardly think so and it would seem wiser to let some projects wait while the good work goes on of devising methods and machines by which more intelligent labor secures more economical results than were ever known before. An acre of corn should be grown or a cubic yard of granite moved with less expense and labor than now, and preferably by Americans. It seems to the writer that Oriental labor would be in competition with the labor of our own people. Would the American Federation of Labor favor the plan? One further objection is the straight lead into politics.

H. F. DUNHAM.[4]